

The Switch to Bioenergy: Potential Major Payoffs ¹

Within 25 years, advances in understanding gene function and regulation could enable both a doubling of U.S. bioenergy crop yields and a significant increase in the efficiency of converting biomass to ethanol. These advancements could significantly reduce both U.S. dependency on foreign oil for gasoline and net CO emissions, while simultaneously improving the economic and environmental health of rural areas in the United States.

A joint DOE and U.S. Department of Agriculture study has shown that doubling yields from bioenergy crops would enable the economic conversion of 55 million acres of U.S. cropland to bioenergy crop production (e.g., switchgrass, hybrid poplar, and willow) with little impact on food production. Combining these increases in energy crop yields with expected improvement in ethanol yields from biomass could lead to the production of 900 gallons of ethanol from biomass harvested on one acre of cropland. Under this scenario, 50 billion gallons of ethanol could be produced annually from U.S. cropland.

Fifty billion gallons of ethanol is sufficient to satisfy 25% of projected 2020 U.S. gasoline needs. This production would increase biomass use from the current 3% of total primary energy use to 6% of projected 2020 primary energy use. Assuming the ethanol is used in an E85 blend (15% gasoline; 85% ethanol) and taking a full life cycle approach to calculating CO₂ emissions, the dedication of 55 million acres of U.S. cropland to bioenergy crops used to produce ethanol would result in an annual avoidance of 406 million metric tons of CO₂ or 111.4 metric tons of fossil carbon emissions. From an energy security perspective, with these enhanced crop and ethanol yields, bioenergy crop production from only 39 million acres could provide enough biomass for ethanol production to displace all projected 2020 oil imports from the Persian Gulf used to produce gasoline.

A life cycle approach accounts for CO emissions associated with all aspects of producing and using ethanol or gasoline.

Additional positive environmental and economic impacts that can occur with the use of ethanol produced from bioenergy crops include decreased chemical and herbicide use for bioenergy crops relative to traditional crops. Furthermore, with appropriate management practices, erosion and chemical runoff can be reduced relative to traditional crop production. Farm income increases with bioenergy crop production (estimated to be in excess of \$6 billion annually). Moreover, estimates are that for every billion gallons of annual ethanol production, there is a \$1.35-billion economic impact including 6,000 jobs resulting just from plant operation. This latter impact results from ethanol plant operation only, and multiplier effects would increase the total expected economic impacts.

¹ORNL Analysis included in the DOE-Office of Science, Genomes to Life Brochure